TURFAX™

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CONTENTS:

JB COMMENTS:

USING CHEMICAL SOIL TESTS

It is surprising how often I have observed professional turf managers struggling with turf problems who have never arranged for chemical soil tests to be conducted on the turf facilities for which they are responsible. Chemical soil tests involve a very minimal cost for the benefits derived. Certainly, there is no excuse for not securing soil tests to provide guidance in proper decision making concerning fertilization of turfs. Consider the possibility of being called before a local city or regional governing body to justify past fertilization practices on a turf facility. Chemical soil tests are excellent documents to present before such a hearing. The chances of obtaining favorable consideration are greatly diminished if no soil tests have been conducted.

Even more surprising are turf sites struggling with problems where soil tests have been conducted, but no action has been taken in terms of adjustments based on the chemical soil test findings. Why is this? Were the soil tests actually read? Is there a lack of confidence in the soil test results? Is there an inability to properly interpret the soil tests?

The macronutrient that I observe being most commonly and severely deficient on turfgrass sites, even though soil tests have been conducted, is potassium (K). Phosphorus (P) is occasionally deficient, especially on high-sand root zones. Among the essential micronutrients, a problem too often encountered that has a potential to create severe turf problems is excessively high zinc (Zn) and/or copper (Cu) levels. If excess levels are indicated by chemical soil tests, it is important to cease the use of micronutrient combinations that include zinc and/or copper, depending on whether one or both are in excess.

An important aid in interpreting trends in chemical soil tests is to develop a separate file in which are recorded a minimum of three years analyzes for each distinct turf area.

The importance of properly understanding, interpreting, and implementing turfgrass nutritional programs based on chemical soil test results can not be over emphasized. My personal experience has shown that **even minor adjustments in nutritional levels can make major differences in terms of the desired turf responses and performance.**

MONITORING THE TURFGRASS MICROENVIRONMENT

Keeping on-site weather records should be a common practice at most turfgrass facilities. The monitoring is accomplished by one or more microenvironmental stations interfaced by wire or radio communications to a computer with software for storing the data. The computer also has a software program for processing the environmental data into daily, weekly, and monthly means for the average, maximum, and minimum levels of individual microenvironmental parameters. A set of suggested guidelines for sensing devices and placement are presented in the accompanying table.

Information on seasonal weather and microenvironmental trends serve as a basis for (a) scheduling future cultural practices, (b) prediction of pest activity, and (c) diagnosis of environmental stress problems. Soil temperatures are effective indicators for shoot growth, root initiation/growth, turf recuperative ability, weed seed germination, timing preemergence herbicide applications, disease development, timing of turf establishment, and scheduling winter overseeding. Net radiation and relative humidity monitoring are valuable in assessing evapotranspiration (ET) rates.

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The goal of the six issue per year TURFAX™ newsletter is to provide international turf specialists with a network for current information about turf. This newsletter is faxed to all Institute Affiliates that use the ISTI technical assistance services on an annual basis. Faxing is more costly, but ensures quick delivery to those outside the United States.

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UPCOMING JB VISITATIONS:

Sept. 5 to 11 - Eastern Oregon & Idaho.
Oct. 4 to 12 - Italy.
Oct. 26 to 31 - Anaheim, California.
Nov. 7 to 15 - Japan.

Suggested guidelines for monitoring microenvironmental parameters over/in a turf.

Environmental parameter	Unit(s)		Sensor location	Monitoring schedule	Sensor type
	English	Metric			
net radiation (300-60,000 nm)	Cal./cm^2/min	W m^{-2}	top of turf canopy	daily cumulative	net radiometer
temperature:					
air	°F	°C	top of turf canopy	hourly	thermocouple - shielded
turf canopy	°F	°C	center of canopy	hourly	thermocouple
soil	°F	°C	1 and 4 inch (25 and 100 mm)	hourly	thermocouple
relative humidity	%	%	top of turf canopy	hourly	psychrometer, shielded and aspirated
wind velocity	miles/hr	m s^{-1}	top of turf canopy	hourly	cup anemometer
rainfall	inch(es)/day	mm d^{-1}	above turf canopy	daily total	collection device

JB VISITATIONS:

June - Italy

A technical visitation to the Italian Golf Federation sponsored fairway-sports field turfgrass research plots near Rome revealed they are progressing quite well. They encompass *Cynodon, Festuca, Lolium, Paspalum, and Zoysia* species and their cultivars.

I then presented a Seminar on Environmental Issues and Turfgrass Benefits sponsored by the University of Pisa. Their Agronomy Department is the oldest in Europe. Over 150 were in attendance including graduate and undergraduate students, university academicians from around Italy, and key industry leaders. A tour of the turfgrass research plots was conducted.

It is interesting to observe these developments in Italy. Some 10 years ago the Italian Golf Federation initiated a two-year turfgrass education program for Italian golf course superintendents. It has been successful and subsequently they initiated a turfgrass research program approximately 5 years ago. Now there are 3 universities that have initiated new undergraduate turfgrass teaching programs, including the University of Pisa where 4 professors are spending time on the turfgrass aspects, with Professor Marco Volterani organizing the Seminar. There also are 4 graduate students studying for Master of Science degrees in turfgrass. More recently a number of universities are becoming active in developing turfgrass research programs. This evolutionary progression is quite similar to what occurred in the United States, but at a much more rapid rate.

June - Eastern Germany

A visitation was conducted to a recently constructed golf course facility in eastern Germany. A number of problems had been experienced during the initial grow-in that seemed to be associated with some atypical soil chemistry in terms of the levels of both essential plant nutrients and nonessential elements. The lands on which this occurred were used in vegetable production and there is no historical record as to the fertilizers and other chemicals used. This increases the problem in interpreting the causal aspects. In this situation tissue tests become especially important in addition to soil tests.

June - Georgia

I visited the Cloisters and their multi-course golf facilities at St. Simons Island, Georgia. This was very special in that I had the opportunity to view a nine hole course designed by Harry S. Colt (1861-1951) and Charles H. Alison (1882-1952), and constructed in 1929. Many consider Colt to be the pioneering father of professional golf course architecture. One of his proteges was Dr. Alister Mackenzie.

The site is a very flat seaside location where Colt has used very large, dramatic bunkers with steep faces. This is characteristic of his 1920's designs and similar to those observed on several golf courses near Paris, such as the St. Germaine Golf Club. This golf course was extra special in that the original design is quite well preserved. There are a number of golf courses in the United States where Colt was involved in the design but which unfortunately have been significantly modified over the years. The Cloisters management is to be congratulated for their preservation of this Colt and Alison designed nine holes of golf.

July - Sydney, Australia

Participated in the 8th International Turfgrass Research Conference held at the University of Sydney in Sydney, Australia. The conference is held every 4 years and is one of the few opportunities for turfgrass researchers and educators from throughout the world to interact on a face-to-face basis. Research papers presented at the conference will be published in a two volume set by the International Turfgrass Society.

BERMUDAGRASSES SUPERIOR IN DEHYDRATION AVOIDANCE AND DROUGHT RESISTANCE WHEN COMPARED TO ZOYSIAGRASSES

by

S.I. Sifers and J.B Beard

The objectives of this investigation were to assess the genetic diversity in dehydration avoidance and resultant drought resistance among cultivars/genotypes of 26 bermudagrasses (*Cynodon* spp.) and 9 zoysiagrasses (*Zoysia* spp.). **Dehydration avoidance** is the ability of a plant to avoid tissue damaging water deficits even while growing in a drought environment favoring the development of water stress.

Turfed plugs of 4 inches (100 mm) in diameter were collected from mature stands of at least 4-years age and transplanted in a randomized block arrangement with 4 replications onto a high-sand root zone. Once the turfs were fully rooted, the irrigation was terminated and assessments made over a 5-month period from 1 May to 5 October, 1988 during which only 2.8 inches (72 mm) of rainfall occurred. This included 1.2 inches (30 mm) on day 40, 0.6 inch (15 mm) on day 55, 0.7 inch (18 mm) on day 69, and 0.35 inch (9 mm) on day 124. Then on October 6 irrigation of the turfs was reinitiated and a normal watering frequency was sustained during turf recovery phase.

RESULTS

Substantial genetic diversity in both dehydration avoidance and drought resistance was found among the bermudagrass (*Cynodon*) genotypes, which encompassed 14 *C. dactylon* and 12 *C. dactylon* x *C. transvaalensis* hybrids (Table 1). The mean leaf firing on day 158 was 51% for the bermudagrass genotypes and 95% for the zoysiagrass genotypes. Similarly, the mean shoot recovery 15 days following reinitiation of irrigation was 80% for the bermudagrass genotypes and 16% for the zoysiagrass genotypes. Bermudagrass cultivars that sustained more than the threshold of 80% green shoots through 158 days were FLoraTeX™, NM43, Ormond, and NMS4 bermudagrasses.

Table 1. Leaf firing percent after 60, 90, 120, and 158 days of progressive severe drought stress and the percent shoot recovery 15 days after the initiation of irrigation for 26 bermudagrass (*Cynodon*) genotypes during the drought stress field study.

Bermudagrass (*Cynodon*) genotypes	Leaf Firing (percent)				Percent Shoot Recovery[2]
	day 60	day 90	day 120	day 158	
FLoraTeX™	0 a[1]	4 ab	11 ab	9 a	100 a[1]
NM 43	3 ab	3 a	9 a	10 ab	100 a
Ormond	0 a	4 ab	9 a	13 ab	100 a
NMS 4	0 a	3 a	11 ab	15 ab	100 a
Midiron	0 a	18 c	22 abc	22 abc	100 a
Santa Ana	4 ab	3 a	25 abc	27 abc	100 a
Tifdwarf	8 abc	14 abc	30 bc	28 abc	93 ab
Tiflawn	3 ab	11 abc	28 abc	30 abc	94 ab
Texturf 1F	0 a	5 ab	32 abc	32 abc	98 a
Numex Sahara	5 ab	5 ab	31 abc	35 abc	98 a
Tifgreen	3 ab	0 a	30 abc	53 cd	98 a
Bayshore	0 a	13 abc	55 ef	56 de	79 abc
Tifgreen II	3 ab	8 abc	61 fg	58 de	84 abc
Midlawn	3 ab	11 abc	28 abc	60 ef	84 abc
Tiffine	8 abc	18 c	46 cd	60 ef	72 bc
Sunturf	0 a	8 abc	53 de	65 fg	88 abc
Texturf 10	11 c	13 abc	51 cd	65 fg	65 cd
U-3	4 ab	10 abc	55 ef	66 fg	68 cd
Pee Dee	0 a	10 abc	31 abc	68 fg	82 abc
Guymon	6 abc	10 abc	71 hi	71 gh	72 bc
Tifway	5 ab	16 bc	78 ij	74 gh	73 bc
Midway	14 e	38 g	70 hi	75 gh	53 d
Everglades	13 de	11 abc	69 gh	79 hi	53 d
Arizona Common	14 e	20 cd	83 jk	79 hi	52 d
Vamont	10 bc	21 e	95 kl	95 ij	52 d
Tufcote	5 ab	25 f	99 l	99 j	21 e

[1] Means followed by the same letter within the same column are not significantly different at the 5% level, LSD t test.

[2] At fifteen days after initiation of irrigation.

Bermudagrasses. Among the bermudagrass genotypes, those with the shorter root systems tended to have poorer dehydration avoidance and drought resistance. In contrast, the genetic diversity in dehydration avoidance was much narrower among the nine zoysiagrasses, which included both *Z. matrella* and *Z. japonica* genotypes. The much poorer dehydration avoidance of the zoysiagrasses when compared to the bermudagrasses was attributed primarily to a shallow root system, plus a higher evapotranspiration rate.

Superior dehydration avoidance, as expressed by an 80% or higher green color retention after 158 days, was found for 4 bermudagrass genotypes: FLoraTeX™, NM 43, Ormond, and NMS 4 bermudagrasses. Six other genotypes were in the same statistical grouping, but were numerically below the 80% green color retention threshold. Tufcote and Vamont had the most severe leaf firing at 99 and 95% after 158 days. Drought resistance was outstanding for most of the bermudagrass genotypes, as demonstrated by the degree of green shoot recovery of the turf at 15 days following reinitiation of irrigation on the plot area.

Assuming an objectionable level of turf discoloration occurs at a 20% leaf firing threshold, all 26 bermudagrass genotypes retained acceptable appearance through 60 days, 23 through 90 days, and 4 through 120 and 158 days. In the case of the zoysiagrasses, all genotypes retained acceptable color through 60 days and 6 through 90 days, with none retaining acceptable color at 120 days and beyond. There were 8 bermudagrass genotypes that exhibited no leaf firing through 60 days. Included were FLoraTeX™, Ormond, Midiron, NMS 4, Texturf 1F, Bayshore, Sunturf, and PeeDee.

Zoysiagrasses. Among the zoysiagrass genotypes, FC13521 had moderate dehydration avoidance at 35% leaf firing after 120 days, with Diamond ranked the next best with 46% leaf firing (Table 2). All nine zoysiagrass genotypes had 85 to 100% leaf firing after 158 days, which indicates an inferior dehydration avoidance mechanism compared to the bermudagrasses.

Shoot recovery following reinitiation of irrigation on the study area indicated that the zoysiagrass genotype FC13521 ranked best in drought resistance of the 9 genotypes, followed by Meyer, Korean Common, El Toro, and Diamond, all being in the same statistical grouping. The other 4 genotypes had the poorest drought resistance of the zoysiagrasses assessed.

Table 2. Leaf firing percent after 60, 90, 120, and 158 days of progressive severe drought stress and the percent shoot recovery 15 days after the initiation of irrigation for 9 zoysiagrass (*Zoysia*) genotypes during the drought stress field study.

Zoysiagrass (*Zoysia*) genotypes	Leaf Firing (percent)				Percent Shoot Recovery[2]
	day 60	day 90	day 120	day 158	
FC 13521	4 a[1]	9 ab	35 a	85 a	33 a[1]
Diamond	9 ab	3 a	46 b	90 a	15 abc
Emerald	6 ab	14 abc	79 cd	96 a	5 c
Dalz 8501	9 ab	8 ab	93 cd	88 a	9 bc
Dalz 8508	3 a	6 ab	99 d	100 a	9 bc
Meyer	5 ab	20 bc	100 d	100 a	29 ab
El Toro	9 ab	24 c	100 d	100 a	19 abc
Korean Common	10 ab	50 d	100 d	100 a	24 abc
Belair	18 b	43 d	100 d	100 a	4 c

[1] Means followed by the same letter within the same column are not significantly different at the 5% level, LSD t test.

[2] At fifteen days after initiation of irrigation.

DISCUSSION

Among the *Cynodon dactylon* genotypes, those developed under warm climatic conditions tended to rank in the top group in terms of both dehydration avoidance and drought resistance, with the exception Midiron; while those developed in the cooler climates with emphasis on cold hardiness tended to rank poorest, with the exception of Everglades.

Previous studies revealed that the *Zoysia* cultivar Meyer possessed better internal tissue dehydration tolerance than the *Cynodon* cultivar Tifway (5). As these results reveal the superior overall drought resistance of bermudagrasses in comparison to the zoysiagrasses, this indicates that the dominant component of drought resistance influencing this differential is the superior dehydration avoidance of the *Cynodon* genotypes, and not the dehydration tolerance.

The key characteristics contributing to the superior dehydration avoidance of the bermudagrass genotypes include: (a) A much greater root depth, density, and biomass (5). The genetic potential for rooting of 11 zoysiagrass genotypes is less than 1.1 feet (0.35 m) (9). In contrast, 24 bermudagrass genotypes had a genetic rooting potential of at least 7 feet (2.1 m) in depth, with the lowest being greater than 4.3 feet (1.3 m) (8). (b) A lower evapotranspiration rate. The zoysiagrass genotypes have a higher evapotranspiration rate under both peak evaporative demand (2, 3, 4, 6) and (c) A more rapid rate of surface wax formation over the stomata during progressive water stress in comparison to the *Zoysia* species (5).

Since the zoysiagrass genotypes had poorer dehydration avoidance in terms of leaf firing percent (Tables 1 and 2), and thus entered drought dormancy earlier, this results in a longer period for the internal tissue water stress to develop. This could be an important contributing factor to the inferior drought resistance even though zoysiagrass has been characterized by better internal dehydration tolerance than the bermudagrasses.

The significant differentials between the bermudagrass and zoysiagrass groups of genotypes in both dehydration avoidance and drought resistance are associated with the environmental conditions under which each originated. That is, the *Cynodon* species evolved under the hot, dry, droughty conditions of southeastern Africa, whereas the center of origin for the *Zoysia* species is in the more humid, wet environment of southeast Asia.

The inferior rooting, dehydration avoidance, and resultant drought resistance of the zoysiagrass genotypes in comparison to the bermudagrass genotypes results in a higher irrigation requirement to maintain actively growing, green turf conditions in the case of the zoysiagrass genotypes.

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